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THE ADVANTAGES OF '𝒜' IN STEAM EDUCATION: EXPLORING SECONDARY TEACHERS' AND STUDENTS' PERSPECTIVES IN HUNGARY AND PALESTINE

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Introduction

STEAM is an acronym for Science, Technology, Engineering, Art, and Mathematics and traces back to a pivotal National Science Foundation conference in 2007, which demonstrates the connection between arts, STEM education, and the workforce. STEAM introduces the additional element of 'Arts' and there are many interpretations of this word (Sanders, 2009). The shift, from STEM to STEAM, gained popularity and urged a broader educational approach beyond STEM disciplines (Colucci-Gray et al., 2017). Supporters of STEAM argue that integrating arts into STEM education can enhance cognitive skills and problem-solving abilities which could improve students' academic outcomes (Sanders, 2009). STEAM enhances students' creativity through analysis, critique, and investigation from an artistic perspective (Floerke, 2021). Furthermore, supporters suggest that integrating arts into STEM education can help cultivate 21st-century skills, and enable students to explore interconnections within STEM subjects and between STEM and other areas of life (Ge et al., 2015; Hopia & Fooladi, 2019; Milner-Bolotin & Milner, 2017).

STEAM education empowers learners to engage in real-world experiences by combining science, technology, engineering, and mathematics standards with art. STEAM education promotes inquiry-based learning, problem-solving, and practical application. Roehrig et al. (2021) describe STEAM as interdisciplinary because many disciplines combine seamlessly to create a cohesive learning environment. STEAM education's objectives are to prepare children to think critically and creatively, cooperate, innovate, and use proper communication (Quigley & Herro, 2016).

This dissertation aims to understand and explore the perspectives of Hungarian and Palestinian teachers and students at secondary schools about STEAM education. It investigates how

STEAM is an innovative and beneficial teaching approach to enhance a student's learning experience.

Background

STEAM in Secondary Schools

When STEAM education is implemented in secondary schools, students can perform better and acquire an improved understanding of a certain subject (Segura, 2017). Students can make better connections to different subjects together by using STEAM in their classrooms (Guyotte et al., 2014). STEAM engages students to practice a balanced education in critical thinking, analytical skills, and creativity to aid in their future careers. It also allows students to develop their communication skills with one another and raise awareness of the importance of cooperation crucial to their career (Connor et al., 2015; Herro & Quigley, 2016). There is a persistent need for ongoing research in STEAM education to understand effective teaching practices. It would be valuable for educators to have access to research-backed methods for developing and implementing STEAM curriculum. STEAM education plays a necessary role in preparing students for higher education and future career endeavors. STEAM-based activities promote engagement among students and can have impactful learning experiences by developing their inquiry-based problem-solving and working independently or collaboratively. Additionally, through a STEAM-based education, students can feel challenged allowing them to be creative, develop observational skills, and expand the right hemisphere of their brain (Hayman, 2017). However, despite the importance of implementing STEAM in secondary schools, there is a lack of formal training for educators in using STEAM concepts and this could lead to ineffective integration (Wang et al., 2011). Educators' attitudes, thinking, experiences, and identity efficacy can influence STEAM achievement. Despite STEAM's popularity, there is a lack of sufficient accessibility of STEAM education at secondary schools. There is a necessity for more exploration into STEAM goals, initiatives, and perceptions to expand STEAM interest and efficiency. Moreover, there is a lack of literature on the perceptions of STEAM education, its impact on the student, and effective implementation and integration in secondary schools. Additionally, there is a scarcity of information regarding K-12 STEAM programs and to embrace STEAM programs, administrators and educators require access to effective models that promote departmental collaboration and co-teaching. While the STEAM movement has been steadily expanding, it still requires more data to substantiate its efficacy. Furthermore, firsthand accounts from educators regarding the practicality of implementation and reflections from students on their perception of interdisciplinary thinking are essential.

STEAM in Hungary and Palestine

The Palestinian government has pursued consistent efforts to enhance educational infrastructure, teacher training, curriculum adjustment, and the establishment of a comprehensive education system. The education system in Palestine witnessed significant challenges during the Intifada leading to the closures of schools and universities. Consequently, private initiatives and non-governmental organizations (NGOs) emerged to address the resulting educational crisis and continue to play a vital role in advancing the Palestinian education system today. In Palestine, compulsory education is mandated for children aged 6 to 15 and, after the tenth grade, students undergo an evaluation to determine what section (science section or literary section) is eligible for secondary school. Secondary education concludes when students complete the Tawjihi examination determining admission to higher education institutions. Vocational training opportunities for tenth-grade graduates are limited, with apprenticeships serving as the primary avenue for skill development. Recognizing the significance of practical and theoretical training, the Palestinian government implemented and offered two-year courses for skilled workers or 5 to 8-month courses for semi-skilled workers. There aren't any specific STEAM organizations or STEAM integration in schools or curricula in Palestine. The Ministry of Education and UNESCO collaborated, funded by the government of Japan, on a project titled "Enhancing Student Competencies for Innovation and Sustainable Development through STEAM and Coding in Palestinian Educational Institutions" in March 2021. The project involved the training in coding, robotics, artificial intelligence, and 21st-century competencies engaging a STEAM methodology for 100 educators and 1,000 students. Participants were equipped with laptops and robotics kits and 60 students were incentivized to engage in the national competitions of the World Robotic Olympiad (WRO), and two teams along with their mentors participated in the 2022 WRO International Finals in Germany. The project demonstrated positive outcomes for students to engage in STEAM activities and displayed collaborative achievements. The Arab American University of Palestine (AAUP) engaged with the Ministry of Education to create the "STEAM Palestine" program in 2019 to integrate Palestinian universities. The program emphasized nurturing students' analytical, problem-solving, and teamwork skills. The program displayed different educational methodologies to foster critical thinking, enhance students' adaptability to contemporary scientific challenges, and develop creativity and positive attitudes toward science, mathematics, and technology among school students. The program was meant to inspire other research initiatives and deepen students' understanding through active participation. Hungarians' education policy is shifting to these new objectives that not only strengthen their knowledge and skills but also their personality and growth as an individual. In public education, Hungarian schools focus on complex educational programs in the fields of natural sciences, mathematics, arts, and entrepreneurship. Therefore, the strategy Hungarian schools are aiming for is in support of STEM education. They want to develop a correlation between teachers of natural sciences to teachers working in STEM education. The European Union is the main source of funds assigned to this education strategy to be implemented in schools. As well, other markets and NGOs have been interested in this new education strategy and are assisting the teachers with the proper tools and instruments. Though, the arts have not been mentioned visual culture and music are very much part of the art education in Hungarian schools. Art classes are constrained in some form, but all students until the age of 18 take some form of art during their education, even for their final exam before graduation, students can choose an art subject for instance, fine arts, instrumental music, or folk dance and continue after graduation with art. Also, students who are very interested in the arts in school can take extra classes to improve their skills and can choose different forms of art at the age of 14. Teachers are educated and qualified to teach two different topics from natural sciences to art for example some teachers have a degree in two subjects- Geography and arts. This is an excellent way for teachers to implement the arts in STEM education (Szabo et al., 2018). STEAM education has been implemented in some schools around Hungary- for instance- the Hungarian Eco-School network was initiated in 2000 and has used 40 pilot schools to portray the success of this plan. It is still being used and in 2006 The Green Kindergarten was introduced and is still present where now more than 2000 members, pre-primary, primary, secondary, and vocational schools are participating (Réti et al, 2015). The main standards and principles for this system reinforce STEM education where transdisciplinary activities are arranged, connecting real-life artists to the school, and meetings and team-building activities can all be seen in this school. Teachers do attend STEAM-related training and workshops to further develop their skills and techniques in their classrooms. Hungary does want to support its talented students where the National Talent Program was created in 2008 to depict the recognition, assistance, and growth of Hungarian talent. The Hungarian Parliament has been giving these opportunities to these students since 2008 and will continue until 2028 to keep supporting them (Szabo et al., 2018).

Another institution that links visual arts with science is the Digital Craft Lab. The Digital Craft Lab is meant to develop and research how arts and science should be connected and has three varieties of activities. Firstly, its members create new technology and materials, create innovative experiments, and then build these new technologies to create experience-based learning programs for schools. STEM is certainly transformed into STEAM and The Digital Craft Lab's logo is "Be STEAM",

> "Our main target of this programme is to develop a methodology that can generate the fusion of knowledge sharing, can transfer modern educational contents, and can integrate them into public education. It should be inquiry-based, so can contribute to the complex and procedural knowledge building".

The institution further develops creative problem-solving and ICT results, many exercises are created for the development of their participants. They promote collaboration, interaction, drawing skills, and knowledge about digital-creating technologies. They are trying to implement their program into elementary schools specifically in subjects of mathematics and sciences. With the application of the program into classrooms, students can generate and create visual works using new techniques which illustrates a positive reaction not only from students but teachers. However, with all positive ventures, some negative aspects will turn up, for instance, teachers found time management, planning, and resources (materials and kits) to be an issue in completing these activities (Szabo et al., 2018).

The decision to focus on Hungary and Palestine as research sites for the collection of data in my Ph.D. thesis is rooted in a deliberate and comprehensive consideration of various factors, including their socio-political contexts, educational systems, and the potential for enriching the scholarly discourse in my field of study. Hungary stands as a compelling research site due to its unique position within the European Union and its rich history of educational reforms and policy developments. As a Central European country, Hungary offers a nuanced perspective on educational practices and policies within the broader European context. Its recent educational reforms, such as the introduction of the National Core Curriculum and efforts to enhance teacher training programs, present an opportune moment for in-depth examination and analysis. Furthermore, Hungary's diverse educational landscape, encompassing both public and private institutions, demonstrates the exploration of the complexities of educational governance, curriculum implementation, and student outcomes. Conversely, the choice of Palestine as a research site stems from its distinctive socio-political context and the profound impact of conflict on its educational system. Palestine's educational landscape reflects the intersection of historical, cultural, and geopolitical influences. The ongoing challenges faced by Palestinian students and educators, including restrictions on movement, resource constraints, and the politicization of education, underscore the urgency and relevance of scholarly inquiry into the dynamics of educational development. Moreover, Palestine's commitment to educational advancement, evidenced by initiatives to strengthen curriculum development and diverse teaching methodologies, presents an opportunity to examine the efficacy of educational interventions in promoting sustainable development. Furthermore, my interest in exploring different perspectives from secondary teachers and students regarding STEAM education played a significant role in selecting Hungary and Palestine as research sites. I aim to provide a holistic understanding of the challenges, opportunities, and perceptions surrounding STEAM education in diverse socio-cultural contexts. Through rigorous data collection and analysis, I seek to uncover insights from the participants regarding STEAM and ultimately, my research endeavors to advance scholarly knowledge.

Research Objectives

This research investigates Hungarian and Palestinian teachers' and students' perceptions of STEAM education by exploring its effectiveness and examining the support for STEAM. Studies have found that integrating a STEAM-based curriculum can be impactful by understanding complex concepts and making real-world connections through this inquiry-based approach (Gross & Gross, 2016). Education needs always to be updated and modernized to provide students with triumph and achievement in their lives and this could be achieved with STEAM implementation (Díaz & Hernández, 2002). Despite the growing interest and popularity of STEAM education, there is limited knowledge about effective instructional practices, the challenges associated with STEAM instruction, and how to integrate STEAM appropriately. Most schools have not adopted a STEAM curriculum due to district policies and an absence of professional development. Nevertheless, research and literature strongly support STEAM and its effectiveness for the learner (Huser, 2020). Since STEAM education is relatively new and not fully comprehensive, this research aimed to gain a comprehensive understanding of teachers' and students' perceptions of STEAM education. The information acquired could offer valuable insights into opinions regarding the value of STEAM education within secondary schools. This research delves into the perceptions of teachers and students regarding STEAM education focusing on its implementation, importance, and support for student development. It proposes to improve scholarly research by investigating attitudes toward STEAM education. The implementation of a STEAM model promotes interdisciplinary learning by engaging both logical and creative aspects of the brain (Anisimova et al., 2019). The research emphasizes the importance of understanding how to support and promote STEAM education in secondary schools. It poses questions for educators and administrators on the necessary resources for effective STEAM learning to prepare secondary school students with essential skills for their education and future careers. Another goal is to also share the positive case studies and research on integrating and utilizing STEAM in the classroom. Lastly, the research will utilize a qualitative approach to investigate teachers' and students' perceptions of STEAM education. The research questions, literature review, and theoretical framework steered the research to uncover insights into how educators and students perceive STEAM education, its implementation, importance, and challenges. Findings from this research can guide educators in accurately describing and implementing STEAM, supporting the development of STEAM initiatives, and promoting student interest in STEAM lessons. There is limited research in Hungary and especially Palestine on teachers' and students' insights on STEAM education at the secondary level and this research aims to display their perspectives and perceptions regarding the importance of STEAM education. As mentioned, the research utilized a qualitative approach to collect and analyze data, beginning with STEAM activities and observations with students and interviews with teachers and students conducted by the researcher. The outcomes of this study can positively influence perspectives on STEAM education by motivating teachers to adopt new teaching methods and practices, as well as, providing school administrators with a deeper understanding of the significance of STEAM education for secondary students. The study participants included educators and students from secondary levels from two schools in Hungary and three schools in Palestine.

Research Questions

These research questions were tackled and expectantly answered throughout the research about STEAM education. What are the benefits of arts in education? How do the arts promote stronger cognitive functions in individuals? What are the challenges of implementing STEAM in the curriculum in Palestine and Hungary? What are the perceptions of teachers, administrators, and students towards STEAM education? How do teachers and administrators view the implementation of STEAM education in their schools? What are the differences between teachers' and students' perceptions of STEAM education? How can schools implement and integrate STEAM education?

Additionally, qualitative research questions were posed during interviews to gain deeper insights into teachers' and students' perceptions and practices related to STEAM education.

Research Design and Methods

The objective of this qualitative study is to investigate, comprehend, and reveal secondary educators' and students' viewpoints and encounters regarding STEAM education. This research has the potential to advance knowledge regarding the implementation of STEAM integration in secondary schools by examining the insights from educators and students. Raising awareness among educators of STEAM education and its methods can enhance its integration into curricula (Bell, 2016; Stubbs & Meyers, 2015; Zimmerman, 2016). Qualitative research was chosen over quantitative research to hold various facets of a situation and define a comprehensive understanding of the main idea (Creswell, 2013). Stake (2010) explains qualitative research as a process aimed at gaining a deep understanding of a single phenomenon and how it operates. Yin (2014) advocates for the triangulation of multiple sources of evidence to enhance the credibility of a research. Therefore, this research seeks and focuses on the outcomes of secondary teachers' and students' perceptions regarding STEAM education. Data collected from the STEAM activities and field notes from student observations will be utilized to triangulate with the interview data. Through the analysis of these documents and interviews, patterns and themes are anticipated to surface (Yin, 2009). Triangulation is a method often applied to explore findings by integrating multiple data sources and serves to improve the legitimacy of a study by examining a situation from multiple viewpoints (Stake, 2010). In this qualitative research, data triangulation is accomplished by gathering responses from participants through open-ended interviews and by using member checking to prove the accuracy of the data (Bogdan & Biklen, 2007). The triangulation approach can minimize any biases and enhance the reliability of the data (Bogdan & Biklen, 2007). In this research, triangulation will be achieved through the use of diverse data sources, interviews, document analysis, observations, and field notes. The research also applies a thematic analysis and follows the methodologies brought forth by Merriam (2002). The researcher possessed the ability to empathize with the participants' lived experiences and essentially captured the relevance of their shared perceptions supplementing the thematic analysis (Shank, 2006). The analysis process involves transcribing the recorded interviews, coding the data, classifying the coded data, and lastly recognizing similar patterns and themes. The analysis began with the STEAM activities and observation, subsequently, the researcher employed the constant comparative method to code and record data until emerging themes became apparent. The constant comparative method entails breaking down the data into meaningful units and coding them into categories (Glaser, 1965). Additionally, documentation and field notes were used to reinforce themes that were applicable throughout the analysis process. The coding process began with open coding involving repeated readings to identify concepts and categories regarding perceptions of STEAM which generated numerous codes. These codes were subsequently organized into categories. The themes were compared with the themes from the research notes and cross-checked against coded citations and the entire dataset. A comprehensive review of the data was conducted to identify any additional themes. The researcher iteratively read and re-read the data to continually identify themes until no further themes emerged. The coding process was guided by the framework and procedures proposed by Miles et al. (2014) and involved two primary phases: the initial coding phase (first cycle) and the subsequent pattern coding phase (second cycle). To begin, the researcher conducted the initial coding phase, where data from interviews was systematically dissected into distinct components. These components were then closely examined and compared to identify commonalities and differences between teachers and students from Hungary and Palestine. This initial coding phase employed two distinct methods: descriptive coding, which entailed assigning concise labels to encapsulate the essence of data segments, and using MAXQDA, which directly employed participants' own words and phrases from the data. The subsequent pattern coding (second cycle) was carried out to condense these summaries into a smaller number of categories and themes. Throughout the entire coding process, the researcher maintained analytic memos, as advocated by Saldaña (2013). These memos served as documentation of the evolving coding process, prompting deeper reflections by the researcher on the significance of the data. They constituted a transitional phase bridging the gap between coding and the subsequent reporting of the study's findings. The data was stored, secured, and protected on the researcher's laptop with a protected password. Each participant had a folder labeled with a number and nationality to distinguish between the participants and maintain participant confidentiality. Original paper documents such as the researcher's field notes and the teacher's observational sheet were stored in a locked file drawer at the researcher's home and were then scanned to have a digital copy and secured in a protected password folder. The final stage was data verification which involved checking the legitimacy of the data by reviewing the transcripts and codes to prove the problem statement (Sarantakos, 1998).

The researcher submitted a research proposal to their faculty, who granted ethical approval before commencing the study for the Hungarian schools, and regarding the Palestinian schools, the researcher contacted the schools directly with the research proposal, information letter, and consent forms. Throughout the research process, the researcher remained conscientious about the potential impact on participants and society as a whole, ensuring appropriate conduct. Kumar (2005) emphasizes the unethical nature of collecting information without participants' knowledge, willingness, and informed consent. Hence, the researcher informed all participants that their involvement was voluntary, and they had the liberty to withdraw from the study at any time. In the course of the study, informed consent was obtained from all participants, who were also assured that they were not obligated to answer any questions that made them uncomfortable.

STEAM activities involve hands-on application, problem-solving, engagement, and collaboration among students. STEAM activities can develop critical thinking, creativity, and innovation, and many of these activities are experimental and realistic where participants learn by doing. This approach is effective because it makes learning more engaging and sparks curiosity, and an exploration to understand the world. Hence, STEAM activities portray a practical application of academic concepts and let learners see real-world applications. Through these activities, individuals can express themselves and appreciate diverse perspectives. In summary, STEAM activities provide practical approaches to education developing learners' skills and abilities to prepare them for successful educational journeys and future careers. Gorman and Clayton (2005) portray observation studies as systematically recording observable phenomena or behavior in a natural environment. Some scholars embed observation within the broader framework of ethnography, while others narrow it down to participant observation. Spradley (1980) suggests that participation observation leads to ethnographic description and portrays ethnography as the task of illustrating a culture with the primary goal of understanding it from the native perspective. Participant observation is a valuable method for gaining insight into participants' perspectives by actively engaging in their activities. This type of method can be triangulated when obtaining the findings from one source or through a different data collection method. Additionally, observations help researchers understand participants' nonverbal expressions and social interactions. During the STEAM activity observations, the researcher will record observations by hand to capture behaviors, movements, tone, and verbal and nonverbal expressions that could provide further insight into the research process. Field notes taken during observations serve as a record of what was observed that aids in remembering certain details later (Merriam, 2002). Researchers employ field notes to thoroughly document nonverbal cues, settings, participant behaviors, and other interactions. These notes are used to interpret participants' perspectives and meanings (Yin, 2014). Additionally, field notes must be rich in description to capture the subtleties. These notes were used to record reflective insights during and after the STEAM activities which followed nonverbal and verbal signals, the physical environment, and participant engagement. The analysis of field notes helped identify any emergent themes and then served for later coding and analysis. Field notes offer a chance to gather additional data and allow the researcher to document and reflect upon observations, thoughts, and experiences related to the research setting and activities. Allen (2017) explains participant observation as the process of entering a group of people with a shared identity to gain an understanding of their community. This process includes gaining knowledge and a deeper understanding of the participants, interactions, and events that take place at the research site. Researchers can gain an understanding of the group once they spend time with a group of people and closely monitor their actions, speech patterns, and norms. Nweke and Nwoba as described in Okolie and Ajene (2019), explain how participant observation serves as a method of gathering data, an approach for inquiry, and an essential element of qualitative research. Additionally, Allen (2017) describes participant observation as immersing oneself within a group and sharing a common identity to comprehend their community dynamic, which entails acquiring in-depth insights into the individuals, interactions, settings, and occurrences.

The participants in this research consisted of secondary teachers and students from two Hungarian and three Palestinian secondary schools. The sample size for this research comprised 23 secondary teachers, one from each grade level between 9^{th}-12^{th} grade, selected from the target schools for the interviews. For anonymity, teachers have been assigned to numbers and their nationality for instance: Hungarian Teacher- HU Teacher 1 or Palestinian Teacher- PA Teacher 13, and so forth. The sample size for the secondary students, for the interviews, comprised 23, one from each grade level and the targeted schools, students as well were labeled the same as teachers for anonymity based on their nationality and assigned number, for instance, Hungarian Student- HU Student 1, Palestinian Student- PA Student 13, and so on. Lastly, 496 students, between grade levels 9^{th}-12^{th}, took part in a STEAM activity and observations for the research.

Before data collection, approvals were obtained from the research institutions with permission from the school principal. The researcher contacted one of the teachers of each school to assist with conducting the STEAM activity in a science and math class between the grade levels of 9th and 12th. The researcher gave the designated math or science teacher for their respective grade level the information letter and consent forms to partake in the STEAM activity for their parents to sign if the student is under 18 years of age. When the researcher obtained all the consent forms, the STEAM activity was conducted with the respective teacher present in the classroom to assist with observational notes. The preparation process for observational notes was to clearly define the objectives of the observation and specify different aspects of student behavior or engagement. The researcher created a structured guide that outlines specific behaviors, interactions, or events to be recorded during the activity. During the STEAM activity, the researcher was observing and recording how the students were engaging and interacting with one another. The researcher also wrote field notes to serve as a written log of immediate observations and emerging themes which demonstrated similarities and differences of student participation. The researcher watched, audio recorded, and documented the students' participation and behavior during the STEAM activity, noting specific actions, interactions, or reactions. The researcher and fellow teacher took detailed field notes to capture qualitative aspects, such as student conversations, expressions, and collaboration. The researcher and fellow teachers have intentionally positioned themselves within the classroom to have a comprehensive view of the students. The researcher walked around the groups, stopping to audio-record and take notes, and choosing optimal vantage points to observe multiple students simultaneously. This allowed for a more comprehensive understanding of the collective experience. Qualitative data, including observations, interviews, and field notes, can be analyzed thematically. The researcher identified recurring themes, patterns, and meaningful concepts that emerged from the data and provided a comprehensive understanding of the qualitative aspects of the STEAM activity. These qualitative measures collectively contribute to a holistic understanding of the STEAM activity and highlight the participants' experiences and perspectives. By employing a qualitative approach, researchers gain valuable insights into the intricate dynamics of art-based methods within the interdisciplinary context of STEAM education. The researcher also employed the constant comparative method by continually comparing new observations with existing codes and themes to refine and deepen the analysis. Lastly, throughout the observation process, the researcher engaged in reflexivity by acknowledging her role as an outsider and how their presence may influence the participants. This self-awareness is crucial for mitigating biases and enhancing the credibility of her observations. By integrating these methods, the researcher collected nuanced qualitative data and displayed a comprehensive understanding of the participants' experiences, emotions, and interactions during the STEAM activity. Thorough note-taking, strategic observation, and thoughtful analysis contributed to the validity of the qualitative research.

Semi-structured Interviews

The interviews in this research are influential in eliciting the perspectives and opinions behind participants' experiences in the context of implementing STEAM and its importance in education. Most of the interviews were conducted in person at the participants' respective schools and online if it was more convenient for the participants. Each interview was either audio recorded or transcribed directly and afterward coded for analysis. The interview questions were designed to obtain participants' perceptions regarding the integration and implementation of STEAM education in secondary classrooms. The preliminary questions centered around whether participants heard the term STEAM and what they knew about STEAM education. Subsequent questions related to the participants' reflection and perception regarding STEAM, their experiences, advantages, challenges, and STEAM integration's impact on students' learning. In the pursuit of my Ph.D. research objectives, the semi-structured interview methodology was selected due to its capacity for fostering in-depth discussions on quality and encouraging personal insights from various participants including students, teachers, and principals within the chosen institutions. This approach was deemed appropriate as it enables direct communication and allows interviewees to express their opinions and values authentically. The researcher was assisted with a list of math and science teachers who were interested in partaking in the interview portion of this research. When the teachers agreed to the interview they signed the Participant Consent Form and the information letter and format of the interview were given to each participant. Individual semi-structured interviews were conducted at times and locations convenient for each participant. All interviews were recorded and conducted in a confidential and secluded manner, with only the interviewee and researcher present. Interviews were optimal for gathering data on perspectives, experiences, and personal narratives (Yin, 2014). The semi-structured interviews consisted of open-ended questions aimed at obtaining teachers' perceptions of STEAM education. Each semi-structured interview lasted approximately 30-45 minutes. Regarding the students' interviews, the researcher asked the students if they were willing to participate, and if so they were given a Participant Consent Form to obtain permission from their parents if under 18 years of age. When the forms were collected, the interview was conducted at their respective schools with a teacher present and the interviews lasted around 20-25 minutes. The semi-structured interviews contained open-ended questions designed to acquire students' perceptions of STEAM education. Each semi-structured interview consisted of twelve questions posed to each participant. The interviews were conducted in English, recorded, and later transcribed for data analysis. All interviews were recorded for accuracy and replayed to ensure precise transcription. Each transcript underwent a thorough review by the researcher at least three times to guarantee accuracy. Research notes were carefully maintained by the researcher to capture relevant gestures, sounds, or noteworthy occurrences during interviews that may not have been captured by audio recordings. The researcher engaged in bracketing by setting aside all preconceptions (Merriam, 2002). The researcher independently analyzed the transcripts which involved a thorough reading and re-reading of field notes and transcripts to ensure accuracy and identify significant statements and meanings. The researcher used a qualitative software planned to highlight and group coded words around meaningful thoughts or ideas in the data, known as categorization. The objective is to discern patterns, themes, and meanings from interviewees' statements and phrases. Lastly, the researcher reflected on what was transcribed about STEAM education to see if the participants' perceptions supported the main problem statement of the research. Participants received advance notice of the interviews, an overview of the discussion topic, the type of information sought, the research's purpose, and how their provided information would be used. Before each interview, participants were informed about the expected interview duration, and ample time was allocated for them to ask any questions related to the research topic. All participants signed a consent form, indicating their willingness to participate while ensuring confidentiality and anonymity throughout the process. The research excluded any identifying details such as their name, age, or school affiliation. Furthermore, given the researcher's role as an insider in the research, measures such as the school teachers were employed to mitigate the potential influence of insider status on data analysis and interpretation. The researcher made sure to be mindful of the participants and focused on questions about the topic. The researcher established a rapport with the participants to encourage candid and transparent responses (Merriam, 2002).

Findings

In recent years, there has been a prominence on preparing students for STEM-related careers and supporting their abilities as creative problem-solvers. Consequently, the shift to integrating the Arts into STEM disciplines, forming STEAM education, has become widespread because it aims at developing students' creative problem-solving skills, collaboration skills, communication skills, critical thinking skills, and more. While existing studies have explored STEAM implementation, there is a lack of research on the necessary support for schools to implement STEAM. This research discussed a plethora of perspectives from secondary teachers and students in Hungary and Palestine. These perceptions were examined and investigated throughout the research and it strived to contribute to current literature. The chapter provides a combination of the research's findings and discussions, limitations, and conclusions. The research employed a variety of data sources, including STEAM activities, observations field notes, and face-to-face interviews to obtain insights from administrators, teachers, and students. The use of triangulation enabled a comprehensive understanding of the subject matter, with field notes and interviews being the pivotal components in documenting the data. Through meticulous analysis, the researcher's transcription of responses and field notes explored the interpretation of the participants' attitudes and experiences concerning STEAM education. This analytical work required a thorough and precise organization, examination, description, and interpretation of the accumulated data. The research focused on # research questions, with a subsequent section presenting the researcher's interpretations and conclusions associated with the existing literature and theoretical framework.

The primary research question How can STEAM education promote a student's learning experience and outcomes? Insights collected from the literature, observations and field notes, and interviews accentuated eleven fundamentals for effective STEAM implementation towards the students' learning experience. The researcher sorted and categorized responses to this research question under the overarching theme of Data analysis involved a rigorous coding process and for the interviews MAXDQA was utilized which identified 5 thematic code groups:

Discussion of the Literature Findings

Commencing with prevalent literature regarding the advantages of STEAM education, the literature demonstrates universally the acknowledgement of the numerous benefits of STEAM education for students. Additionally, they recognized STEAM as a student-centered approach highlighting the importance of teaching them the skills necessary for addressing real-world challenges. The evolving secondary education is slowly transitioning from discipline-specific structures to thematic or conceptual frameworks (NRC, 2011). This transition requires educators to adopt a systemic perspective and foster broad content knowledge. Yet, it is vital for teachers to competently facilitate STEAM-themed curriculum with substantial and ongoing professional development (NRC, 2011). Participants in the study displayed the importance and the adoption of an inquiry-based approach to learning and highlighted the importance of students engaging in real-world problem-solving activities. This perspective is shown in Hoachlander and Yanofsky (2011) explaining that STEAM concepts incorporate a hands-on approach, inquiry-based, real-world, and project-based interdisciplinary programs. Conversely, Wang's (2012) earlier work implies the significance of STEAM by school administrators and educators, however, many secondary teachers lack a comprehensive understanding of how to implement and teach through this approach. Lantz (2009) further advocates for a transdisciplinary approach by pushing problem-solving, innovation, inventiveness, confidence, and technological literacy. Thus, educators should create opportunities for students to explore their interests collaboratively within a beneficial learning environment. Expanding on this idea, teachers and students have expressed that STEAM education promotes collaboration through team-based tasks and enhances academic merit by conducting hands-on learning experiences and this perspective is seen in literature from Lantz (2009) portrays that STEAM education raises student collaboration when conducting group projects or activities. STEAM education seeks to improve and stimulate students' skills in innovativeness and creativity (Gettings, 2016; Land, 2013). Other scholarly literature also depicts the development of creative thinking and is a fundamental skill for students in their educational experience (Conradty & Bogner, 2018; Guyotte et al., 2015; Liao, 2016). According to Hartle et al. (2014), the arts assist in cognitive functions where the arts involve both the brain and the body in a unified method of learning. Blanken-Webb (2014) also supports how the arts play a role in shaping cognitive development by connecting emotions leading to empathetic connections and emotional and interpersonal experiences. Art-based methods present learners with a pathway for expression, communication, and connection through innovative and creative means vital for a successful career (Hartle et al., 2014). Furthermore, Shernoff et al. (2017) further signify the prominence of innovation and creativity in STEAM education. When students participate in STEAM education, students' unique expressive abilities are displayed thereby fostering student engagement (Blanken-Webb, 2014). The participants in this study identified essential components of STEAM education that boost their collective understanding based on an inquiry-based learning approach and meaningful problem-solving. Yakman (2012) delved into student ownership over learning through experiential learning. Additionally, Margot and Kettler (2019) emphasized the student benefits from STEAM's open-ended, student-driven, and problem-solving approaches; these approaches are crucial for nurturing 21st-century competencies and collaborative skills essential for their future careers. STEAM education incorporates creative thinking methodologies, including design thinking. Research reveals when students are engaged in design they display a deeper comprehension of the topic or project (Gess, 2017; Gross & Gross, 2016). The findings displayed the significance of collaborative efforts in understanding and conducting STEAM activities. Kasza and Slater (2017) described the usefulness of teamwork over individuality because teamwork promotes the sharing of meanings and insights relevant to problem-solving tasks. Educators require time, patience, and collaborative support to feel confident in implementing STEAM and fostering student-led learning experiences (Moon, 2020). This statement implies a need for educators to create a culture of teamwork and collaboration to conduct and integrate STEAM education (Holmlund et al., 2018; Radziwill et al., 2015). Sabol (2010) highlighted the unprecedented challenges, opportunities, and potentials faced by individuals in the 21st century by presenting the need for educators to equip learners with essential skills to navigate the evolving technological, occupational, and global landscapes. With advancements in technology and globalization, educators need to tackle the task of fostering adaptability and initiating problem-solving learners to thrive in an environment characterized by constant change (Winthrop et al., 2017). Thus, educators are entrusted with the responsibility of preparing students to succeed in dynamic 21st-century environments and future professions. Amidst educators' endeavors to support students' capability of applying both subject knowledge and acquired skill sets within a global context, STEAM education has emerged as a practical approach in secondary classrooms to achieve the necessary educational outcomes for the 21st century (Doinger & Sydow, 2016). Overall, STEAM education allows students to learn about relevant topics and engage them through real-world problems, this aligns with the 21st Century Skills and the P21 framework. The teachers and students of this research corresponded with the findings of Oner et al. (2016) on the role of STEAM integration in fostering students' creativity. Additionally, they underlined the importance of instructional approaches using project-based learning opportunities or having science fairs confirming with the literature regarding these pedagogical strategies in helping an effective STEAM integration. Competence in both content knowledge and effective pedagogical strategies significantly influences the efficacy of integrated STEAM instruction (Caprara et al., 2012). This statement is agreed also with Cotabish et al. (2011) displaying the necessity for educators to adopt new trends and teaching methods. However, Dugger (2010) explains that financial constraints can affect teachers to obtain the proper resources for training and implementing in their lessons. The obstacles to STEAM implementation discussed by the teachers mirror other research discussed previously. Bell (2016) discussed the need for teacher support or training to improve their understanding of STEAM integration which was also discussed during the interviews with the teachers and administrators. Teachers have mentioned the need for professional development opportunities to integrate and approach STEAM education effectively. This viewpoint is seen through different literature from Doniger & Sydow, 2016 and Jones et al., 2016. Berlin and White (2012) and Wang (2012) also concur that providing teachers with training and preparation in STEAM can enhance science education by developing inquiry-based and hands-on learning approaches. Another noticeable finding pertains to the challenge of garnering support for resources and tools for STEAM implementation which aligns with existing literature. Vann (2013) also observes the financial restrictions many educational institutions face and underscores the importance of ongoing education and experiential learning opportunities to facilitate students' comprehension of STEAM applications.

Discussion of the Theoretical and Conceptual Framework

A few well-renowned theorists and their theories were discussed throughout the dissertation. The idea that STEAM education focuses on a student-centered approach was first delved into by prominent developmental theorists: Lev Vygotsky, Jean Piaget, and Carol Dweck. The research aims to underscore the implications for instructional design, educational practice, and learner development within the contemporary educational landscape. In the context of STEAM education, Vygotsky's theory underscores the significance of collaborative learning environments where students engage in discussion and problem-solving activities. (Vygotsky, 1978). According to the principles of social constructivism, knowledge construction is a product of social interactions and is shared rather than individually acquired (Lincoln & Guba, 2013). The findings align with this notion, as participants described STEAM education as a collective work (Guba & Lincoln, 1994). Guyotte et al. (2014) elaborate that STEAM practices depend on collaborative efforts among all stakeholders by placing STEAM as a social practice involving teachers, students, administrators, parents, and other participants. Participants conceptualized STEAM education as a socially constructed phenomenon wherein teachers transition from traditional, teacher-centered approaches to facilitative roles guiding student-centered learning. Within STEAM disciplines, learners are offered opportunities to work in teams, draw upon diverse perspectives, and co-construct knowledge through interaction with classmates. These collaborative activities develop students' communication, teamwork, and critical thinking skills vital in STEAM fields. Similarly, Piaget's constructivist theory demonstrates that learning is an active process of learning knowledge through interaction within a specific environment. In the framework of STEAM education, Piaget's theory draws attention to the importance of a hands-on learning experience enabling students to explore, direct, and investigate real-world issues. When learners learn through inquiry-based approaches, such as project-based learning, students are engaged in life-like scenarios that require the application of disciplinary knowledge and experimentation. Carol Dweck's mindset theory presents the role of beliefs about intelligence and learning in shaping motivation, effort, and achievement. Dweck's theory portrays the importance of fostering a growth mindset because it promotes risk-taking, resilience, experimentation, innovations, and creative problem-solving. The growth mindset theory can be seen through the teachings of STEAM education because STEAM promotes students' learning development through creative and innovative tasks and methods. Therefore, these theorists delved into diverse concepts regarding a student-centered teaching approach that can be seen in modern settings such as STEAM education. Educators can design and implement pedagogical practices that foster collaborative inquiry, authentic engagement, and growth-oriented mindsets, influenced by these theories, and in so doing learners are prepared and equipped with the suitable knowledge and skills for the 21st-century global economy.

Practical and Policy Implications

Globally, education is changing constantly and different methods and approaches emerge in the classrooms, however, in the contemporary educational discourse, the Partnership for 21st Century Learning (P21) framework has appeared as an essential guideline for educators and policymakers to prepare learners' skills and competencies required in the 21st-century. This section explains the practical and policy implications of integrating P21's framework of 21st-century skills into STEAM education, clarifying the potential to cultivate a workforce adept at navigating the complexities of a rapidly evolving global landscape. The P21 framework articulates a comprehensive set of interdisciplinary skills, often referred to as the "4C's", *"critical thinking, communication, collaboration, and creativity"*, also obtaining information literacy, media literacy, technology literacy, and life skills. The components of P21's framework can be compared with the principles of STEAM education, in which educators promote P21's skills into STEAM pedagogy. For instance, critical thinking is connected to the inquiry-based approach, a characteristic of STEAM education and demonstrated in the P21 Framework in which students engage in authentic, problem-based learning experiences to analyze, evaluate, and produce information from diverse disciplinary perspectives. Other skills such as communication and collaboration, are two interrelated skills emphasized within P21, and these two skills occur within the collaborative learning environments, a trait also displayed in STEAM education. Project-based learning and interdisciplinary teamwork allow students to improve their ability to articulate ideas effectively by having lively and diverse discussions in a teamwork setting. Additionally, communication skills foster interpersonal competencies, empathy, and cultural proficiency essential for learners in the global context. In addition to the development of the 4C's, P21's framework encompasses information literacy, media literacy, technology literacy, and life skills which are central to learners in this digital age and can be seen when integrating STEAM into classrooms by using different technological tools to enhance a student's learning experience. Thus, when these skills and approaches are integrated into curricula, educators ensure students with the critical skills are responsible for lifelong learning. In terms of a policy perspective, the integration of P21's Framework into STEAM education highlights the necessity of interdisciplinary approaches to curriculum design, teacher professional development, and educational assessment. Moreover, policymakers and institutions should invest in teacher training, instructional resources, and educational technology to encourage educators to implement different pedagogical practices that connect 21st-century skills within STEAM disciplines. Michael Fullan's Changing Theory also offers insights into the dynamics of learning, cognition, and pedagogy. The Changing Theory explains that learning is a dynamic and repetitive process characterized by constant adaptation and transformation. Learners are actively constructing and reconstructing knowledge through interaction with their environment, classmates, peers, and culture. STEAM education correlates with Fuller's Changing Theory with its nature of inquiry-driven learning experiences, from student exploration, experimentation, and discovery and connecting it to real-life instances. Moreover, the integration of the arts within STEAM curricula offers opportunities for creative expression, exploration, and imaginative play paralleling Fuller's emphasis on the role of emotion, creativity, and embodiment in learning. One practical association of integrating Fuller's Changing Theory into STEAM education promotes student agency, independence, and ownership in their learning environments. Moreover, with the notion of collaboration and feedback, educators empower students to co-construct knowledge, challenge one another, and explore multiple perspectives. In conclusion, the correlation of P21's Framework of 21st-century skills and Michael Fullan's Changing Theory with STEAM education holds profound practical and policy implications for promoting an experience equipped with the proper knowledge, skills, and tools vital for success in the 21st century. Educators should strive to improve students' critical thinking, communication, collaboration, and creativity alongside technology literacy, and life skills within STEAM learning environments. Educators and policymakers can empower students to thrive and be innovative in an increasingly interconnected and complex world.

The qualitative analysis displayed a common perspective among both Hungarian and Palestinian teachers and students, where they acknowledged the essential value of STEAM education and its impact on developing a learner's skills. Conversely, participants indicated challenges and a need to change and aid teachers in implementing an effective STEAM initiative in classrooms. As pointed out from responses to the Interview Question, which explored the insights into the primary challenges confronting STEAM education in terms of time management, lack of resources, and professional development, reiterates what the Change Theory emphasizes regarding change-oriented perspectives when shaping a new teaching method-STEAM- in curriculum implementation. In addition, the Framework for the 21st Century portrays, as mentioned previously, essential skills such as critical thinking, creativity, innovation, and problem-solving to be successful in the global setting. The qualitative analysis reinforced what the Framework for the 21st Century states especially during the interviews in response to Questions, clarifying participants' perspectives on STEAM education and the skills learners can achieve once STEAM is successfully implemented in the classroom that align with the goals of the 21st Century Skills Framework. The four main C's the Framework demonstrates are relevant and echoed by the participants emphasizing the importance of creativity, critical thinking, communication, and collaboration in developing a student's skills. These skills ensure students' readiness for post-education interests and career efforts. The findings draw attention to embracing a change in educational settings to support the principles the 21st Century Skills Framework brought forth to reinforce the efficiency and continual STEAM education initiatives.

STEAM Activity and Observation

The aim of conducting the STEAM activity and observations was to investigate the similarities and differences in student engagement and collaborative efforts in creating a STEAM project within a math and science class context. When comparing the experiences of Hungarian and Palestinian students during the STEAM activities, several notable differences and similarities emerged. Hungarian students seemed to have access to more technological resources and educational infrastructure compared to Palestinian students, potentially influencing their technical proficiency and problem-solving abilities. Palestinian students face socio-political challenges and resource constraints that impact their access to educational opportunities and extracurricular activities. Hungarian students engaged in STEAM activities conducted in their native language, facilitating clear communication and comprehension of instructional materials. Palestinian students, whose primary language may vary (*e.g*., Arabic, English), may encounter language barriers that impact their understanding of STEAM concepts and instructions. Hungarian students, generally residing in more affluent and stable socio-economic environments, may have greater access to educational resources and extracurricular opportunities that support their STEAM learning experiences. Palestinian students, facing economic hardships and political instability, may exhibit greater resilience and adaptability in navigating challenges encountered during STEAM activities. The findings revealed similarities in the levels of engagement and collaboration among students from both Hungary and Palestine by displaying enthusiasm and cooperation throughout the STEAM activity. Additionally, students seamlessly integrated prior knowledge and concepts from mathematics and science to create their geometric or green city and displayed a comprehensive understanding of the STEAM activity. The collaborative nature of the STEAM activity encouraged students to express their creativity through artistic elements incorporated into their projects and created diverse perspectives on the same activity. As stated by Guyotte et al. (2015), the concept of collaboration when students engage with one another engagement is a better way of learning than doing it individually. During the activities, Hungarian and Palestinian students demonstrated their ability to be creative and innovative. Liliawati et al (2018) express how STEAM education encourages learners to be unconventional and to be creative thinkers. Educators should embrace and promote creative expression within their classrooms because it provides opportunities for students to explore unconventional solutions and use their imagination. Another key element that promotes and impacts creativity is the formative feedback from educators (Calavia et al., 2021). The perception of feedback originated in many fields and Skinner, an American psychologist, introduced the notion of "procedural teaching", emphasizing the significance of immediate feedback for students by promptly correcting their responses (Rinvolucri, 1994).

Subsequently, educators need to provide students with feedback information to facilitate improvement, adjustment, or reconstruction of their knowledge frameworks (Winne & Butler, 1994). Feedback to students during the instructional process is an influential factor in their learning journey and establishes effective learning (Hattie & Timperley, 2007; Hattie, 2008) (Shen et al., 2021). In summary, while Hungarian and Palestinian students may face distinct challenges and opportunities within the STEAM learning context, their shared experiences underline essential skills such as fostering critical thinking, collaboration, creativity, and innovation skills.

Semi-structured Interviews

STEAM education has gained significant attention globally for its potential to foster critical thinking, creativity, and innovation among students. Understanding the perspectives of both teachers and students from diverse cultural and educational backgrounds is essential for informing effective STEAM pedagogy and practice. Semi-structured interviews were conducted with Hungarian and Palestinian teachers and students to explore their perspectives on STEAM education. The interviews focused on themes such as the perceived importance of STEAM, challenges and barriers to STEAM implementation, and strategies for enhancing STEAM learning experiences. Thematic analysis was employed to identify common themes and divergent perspectives across the participant groups. The participants' insights portrayed STEAM to be interdisciplinary and highlighted STEAM's learning outcomes for students from its practicality, engagement, and collaborative features demonstrated in the 21st-century skills. They also expressed how STEAM promotes motivation to learn different concepts through problem-solving and critical thinking. These qualitative findings coincide with existing literature, supporting STEAM's effectiveness in developing students' learning skills by conducting effective efficacy in hands-on, project-based learning activities, as mentioned in research from Christensen, Knezek, and Wood (2015) and Brouillette and Graham (2016). Hungarian teachers emphasized the significance of STEAM education in preparing students for future careers and highlighted the importance of hands-on learning experiences and interdisciplinary approaches in fostering students' problem-solving skills and creativity. Palestinian teachers expressed the transformative potential of STEAM education and how it fosters innovation and empowers students to become critical thinkers and instruments of change in their communities. Despite contextual differences, both Hungarian and Palestinian teachers recognized the value of STEAM education in preparing students for the demands of 21st-century skills. They highlighted the importance of fostering creativity, critical thinking, and collaboration through hands-on, inquiry-based learning experiences. Policymakers and educators should prioritize equitable access to resources and professional development opportunities to support effective STEAM implementation across diverse educational settings. Moreover, fostering partnerships between schools, universities, and community organizations can enhance STEAM learning experiences and promote inclusive participation among students from marginalized backgrounds. Hungarian students demonstrated a keen interest in STEAM education, viewing it as an avenue for exploring their creativity, problem-solving abilities, and future career prospects. They highlighted the significance of hands-on learning experiences and collaborative projects in fostering their engagement and enthusiasm. However, both students and teachers acknowledged challenges such as limited access to resources and the need for more professional development opportunities to effectively implement STEAM initiatives. Moreover, Hungarian students expressed enthusiasm for STEAM activities, citing opportunities for collaboration, experimentation, and real-world application of theoretical concepts. Palestinian students expressed similar enthusiasm for STEAM education, recognizing its potential to empower their skills in critical thinking, creativity, and problem-solving. However, they also identified barriers such as infrastructure limitations and lack of resources, which hindered equitable access to STEAM opportunities. The qualitative and quantitative data gathered to explore the third research question, about the perceptions of teachers and administrators regarding the support and sustainability of STEAM programs in their educational institutions, yielded pertinent insights into the relationship between these two cohorts. To elucidate how qualitative findings complemented quantitative results, the researcher conducted in-depth interviews with participants, posing probing inquiries such as delineating the requisite skills for students within an efficacious STEAM program, strategies for administrative backing and perpetuation of such programs, and identification of potential lacunae within the current STEAM framework. Collectively, responses to the research question- regarding the challenges teachers face when attempting to implement STEAM- teachers underscored the need for training and resources. These findings from the teachers are supported by studies, such as a study by Quigley and Herro (2017), their study displayed the need for professional development opportunities for teachers and should be a pivotal step toward enhancing educators' understanding and implementation of STEAM. The research conducted by Boice, Jackson, Alemdar, Rao, Grossman, and Usselman (2021) and by Mastrorilli, Harnett, and Zhu (2014) also demonstrates the need for teacher training when implementing STEAM in the classroom. Moreover, the study conducted by O'Leary and Thompson (2019) depicts the need for a comprehensive and interdisciplinary educational framework incorporating the arts to promote students' creativity and cognitive development and parallels the findings from teachers and students during the qualitative analysis. Therefore, the qualitative analysis demonstrated a shared understanding and appreciation for STEAM's pedagogical advantages. The overarching conclusion proposes a perceived need for STEAM education and its imperativeness to bridge existing gaps and enhance the efficacy of STEAM initiatives in educational settings.

Limitations

This study offered and demonstrated insights into educators' perspectives on STEAM integration in secondary educational settings, however, several limitations constrain the validity and applicability of its findings. Predominantly, the research was limited to five schools within two countries, thereby limiting the extent to which the findings can be inferred to broader educational contexts. Sampling limitations constituted another notable constraint, primarily stemming from the restricted number of participating schools within the district. The geographical context added another layer of complexity by conducting interviews in Hungary introduced the potential language barrier, as not all teachers and students may have English as their first language. This raised concerns about accurate transcription and understanding of their answers which could compromise the integrity of the data collected. Another challenge that arose when trying to find schools in Hungary, is the lack of acceptance from schools to conduct my research. That is why I was only able to attend two schools in Hungary instead of three like in Palestine. It was easier to secure access to the schools and conduct the research in Palestine as I was a former teacher in Palestine, so schools already knew who I was and conducted my research at a previous school where I was employed. Another limitation that was displayed while conducting research was engaging with interviewees, particularly students aged 14-18 in both regions. The willingness of participants to share their opinions and be recorded emerged as a potential limitation where some students were not fully comfortable participating in interviews or having their perspectives recorded, adding a layer of complexity to data collection, also some students had a hard time expressing themselves or could not give an in-depth perspective regarding the questions being asked. Furthermore, the wide scope of STEAM education, spanning from kindergarten to adulthood, imposed a focus on a specific age group. This strategy introduced the potential for bias in understanding STEAM education because the perceptions of this selected group may not fully capture the broader challenges and opportunities presented by STEAM. Another hurdle displayed throughout the research was school closures due to COVID-19. The global COVID-19 pandemic and its associated factors influenced the outcomes of the research. The research revolved around participants in educational settings, and with the pandemic, the participants' views could have hindered their perceptions of STEAM education within their classroom contexts. Furthermore, differences in interview length introduced limitations to the depth of understanding acquired from participant responses. The researcher made efforts to conduct comprehensive interviews, some interviews ranged from 25 to 40 minutes in duration, however, shorter interviews as brief as 15 minutes, impaired the thorough exploration of participants' perceptions of STEAM education. Nevertheless, despite these limitations, the data analysis process produced valuable insights beneficial to the research's objectives.

Recommendations for Future Research

The dissertation's findings can recommend future educators, administrators, and stakeholders to allocate both time and financial resources toward implementing diverse professional development initiatives for educators to integrate STEAM. Armknecht (2015) displays STEAM effectiveness from well-trained educators and administrators through inquiry-based teaching that aligns with the conceptual framework for 21st-century learning. The Teaching and Learning International Survey (TALIS) conducted by the Organization for Economic Cooperation and Development (OECD) in 2009 illustrated a positive connection between professional development and teachers' self-efficacy. Another recommendation is to propose a curriculum that integrates technology, arts-based methods, 21st-century learning frameworks, interdisciplinary skills, and creativity under the context of Change Theory. Therefore, implementing STEAM in secondary schools, and funding for proper materials and tools are necessary to create STEAM projects, facilitate collaborative time for educators, develop STEAM curricula, and provide interdisciplinary professional development opportunities. Stansbury (2011) highlights the importance of having available resources to implement STEAM programs. The adoption of new instructional practices needs training and support to enhance teachers' self-efficacy in differing teaching methods (Gess, 2017; Margot & Kettler, 2019; Stein & Muzzin, 2018). DeJarnett's (2018) case study depicts the positive impact of professional development and support on teachers' self-assurance in STEAM implementation. Schools must detect and modify their environments by considering both the local environment and available resources. Similarly, awareness of external resources and professional connections enhances the real-world relevance of school activities. Future research could explore students' perceptions of STEAM education in broader and global contexts. These research endeavors could entail conducting investigations into the perceptions of STEAM across diverse school districts in various cities and countries to understand the diverse perspectives of people from a geographical, cultural, or political viewpoint. This study, while insightful, focused on examining the perceptions of STEAM education among participants from only five schools in two different countries so the sample size did not fully represent all secondary schools in their districts, thereby constraining the generalizability of the findings. Therefore, future research should strive to encompass a more diverse selection of participants to provide a broader and more profound understanding of the research questions. To further enhance this research, expanding the study to incorporate parents of the students or various stakeholders' perceptions of STEAM would enrich the research methodology by incorporating controlled observations, polls, and comparative analyses between different participant groups. This would create a comprehensive exploration of the benefits and challenges associated with STEAM education. Moreover, to enhance the thesis' findings, the researcher proposes conducting multiple mixed-method studies across diverse regions nationwide, thus, developing authentic results by incorporating input from educators and administrators with varied experiences and expertise to train secondary teachers to implement STEAM education in their curricula. Rolling (2016) portrays the significance of a collective culture to obtain shared understandings and common STEAM goals. As well, Holmuld et al. (2018) support a collaborative, reflective, and iterative culture to implement STEAM education among educators.

Conclusion

A qualitative approach was utilized and the findings of this research revealed that both Hungarian and Palestinian teachers and students shared similar perceptions regarding STEAM through qualitative interviews, STEAM activities, and observation. Despite an awareness of the importance of STEAM education, teachers and administrators may not always grasp its full scope. Participants in the study interpreted STEAM education differently based on their experiences, education level, and background knowledge, yet exhibited similar understandings of its meaning, significance, and associated challenges. Other research and studies demonstrated positive and effective implementation of STEAM in classroom settings from primary to university. The findings, implications, and recommendations from this study contribute to ongoing efforts to enhance perceptions of STEAM education. In summary, the perspectives from both Hungary and Palestine unite in acknowledging the transformative potential of STEAM education. The emphasis on skill development ranging from creativity and communication to collaboration, critical thinking, and real-world application assists as proof- of the effectiveness of integrating art into STEM pedagogy. The thesis delved into the workings of integrating the arts into STEM and switching the paradigm to STEAM. The many benefits of incorporating the arts into education were displayed during this study. Beginning with creativity, a foundation of artistic expression emerges as a powerful influence that allows students to approach problems and tasks in diverse and unconventional ways. It grants them the freedom to explore their unique perspectives and it develops an environment of individuality and innovativeness. Teachers should encourage students to express themselves artistically when the educational paradigm shifts from a passive attainment of information to an active, participatory experience. The arts provide a platform for self-discovery and self-expression allowing students to communicate their ideas with certainty. Collaboration and cooperation are essential skills in the ever-evolving landscape of the 21st century in education and careers and the arts become an integral part of the classroom to develop those skills. Students engaged in shared creative endeavors where they learned to view and accept diverse perspectives and work collectively towards a common goal. The collaborative aspect infused through artistic expression lays a foundation for effective teamwork, a skillset that excels in academic domains and is relevant in real-world scenarios. The integration of the arts into STEM education sparked critical and problem-solving thinking skills. The challenges presented by artistic efforts prompt students to think analytically showing resilience and adaptability. Artistic exploration encourages a mindset where problems are viewed as opportunities for growth contributing to their development in real-life contexts. The research demonstrated the perspectives and insights of high school teachers and students in Palestine and Hungary. This research showed a comprehensive understanding of the different ways in which the arts can enhance education across diverse cultural and educational contexts by examining the experiences of students and educators in these different settings. In other words, the research aimed to paint a picture This research aspires to contribute to the ongoing dialogue surrounding STEM and STEAM education and seeks to challenge preconceived notions about it. The research insists on a shift in the mindset about the integral role of the arts in the educational landscape by emphasizing the numerous benefits that the arts bring to STEM education. As well, this research is trying to bridge the gap between disciplines and foster a more complex and inclusive approach to learning. The findings of this study not only add depth to the academic discourse but also carry implications for educational policies and practices that advocate for an enriched curriculum that acknowledges and celebrates the arts in STEM subjects. Moreover, integrating STEAM programs in secondary schools has the potential to positively impact education by providing students with essential tools to address global challenges.

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